RESPONSE TO OFFICE ACTION SUMMARY

Examiner Ruth A. Davis.

Pertaining to Office Action Summary dated September 19, 2001, regarding patent application serial number 09/ 734,488, filed by Gene E. Lightner 12/11/2000, response to Office Action is enclosed within, and is referred to by numbers within the Office Action Summary.

1. Referring to claim 1, the phrase "carbon dioxide, containing humidified ethanol," is a definite statement and is supported within the specification page 5, lines 2-11. "The present invention in its broadest aspect, provides a method to withdraw ethanol from a fermented broth contained within a fermentation vessel. The preferred embodiment of the method employs carbon dioxide, supplied to the fermentation vessel, to humidify ethanol. Ethanol from the broth is transmitted to and co-mingled with carbon dioxide to humidify the carbon dioxide. The carbon dioxide containing humidified ethanol and carbon dioxide produced by fermentation is removed from the fermentation vessel and substantially separated from the ethanol. Carbon dioxide, substantially separated from the ethanol, is then purged of carbon dioxide to substantially equal carbon dioxide formed from fermentation. The carbon dioxide is then recycled to humidify additional ethanol within fermented broth. Consequently the fermented broth provides ethanol to humidify carbon dioxide which is then separated from the fermentation vessel". Furthermore, within the specification page 3, lines 22-26, "Raoult's law predicts that any volatile compound within a fermentation broth will form a partial vapor pressure of the volatile compound depending on the vapor pressure and mole fraction of the volatile compound within the fermentation broth. The equation used for humidity allows, that when a gas is humidified, the humidified gas may contain any partial vapor pressure of a volatile compound". Stated within the specification page 3, lines 28-29, for additional information, review F. Daniels, Outlines of Physical Chemistry and G. G. Brown, et al., Unit Operations. Accordingly, the phrase "carbon dioxide, containing humidified ethanol," should be allowed within claim 1.

Claim 1 is amended as follows, 1. (amended) A method to separate ethanol from a fermentation broth,

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which comprises:

providing a fermentation vessel within which ethanol and carbon dioxide are produced, and

providing a mixture of microorganisms, nutrients and sugars to form a volume of broth contained within said fermentation vessel, and

subjecting said broth within said fermentation vessel to fermentation to form ethanol and carbon dioxide, and providing a controlled flow rate of gaseous carbon dioxide to said fermentation vessel to humidify ethanol to regulate concentration of ethanol within the broth to between about 6% to about 12%, and separating the carbon dioxide, containing humidified ethanol and carbon dioxide produced by fermentation, from the fermentation vessel, and

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removing [means for separation of] ethanol from the separated humidified carbon dioxide to substantially remove ethanol from carbon dioxide to provide carbon dioxide to humidify ethanol, and separating sludge and broth from said fermentation vessel, and

providing said mixture, to replace the volume of separated sludge and broth, to maintain substantially constant volume of broth within the fermentation vessel thereby removing ethanol within broth, to regulate concentration of ethanol, and removing carbon dioxide from the fermentation vessel.

Sludge is formed by fermentation within a fermentation vessel and removed from the vessel, for example, taught within U S patent 6,258,175, FIG 3.

Claim 1, lines 1-6 states, "What is claimed is: **1**. A method to separate ethanol from a fermentation broth, which comprises: providing a fermentation vessel within which ethanol and carbon dioxide are produced, and providing a mixture of microorganisms, nutrients and sugars to form a volume of broth contained within said fermentation vessel." The phraseology within the specification page 6, line 26, is "Referring to **Fig. 1,** a mixture of microorganisms, nutrients and sugars **10** is provided." Accordingly sufficient antecedent basis for the phraseology "said mixture" has been established within the specification, page 1, line 10, which states, "These factors are controlled by addition of a mixture." Steps within Claim 1, which occur, are delineated by and preceded by a comma to establish procedure of the method and is unintended to be merely descriptive in nature. Also supporting this operation, taught within U S patent 6,258,175, claim 7 provides for maintaining an established nutrient composition in fermentation broth.

Considering claim 2, the term "substantially maintained" is supported within the specification page 1, lines 7-8, states "Fermentation broth contains sugars, microorganisms and nutrients maintained at a pH and temperature to influence rate of fermentation to form ethanol." Hence said fermentation broth contains nutrients substantially maintained to provide nutrients within fermentation. Also supporting this operation, taught within U S patent 6,258,175, claim 7 provides for maintaining an established nutrient composition in fermentation broth.

fermentation. Also supporting this operation, taught within U S patent 6,258,175, claim 7 provides for maintaining an established nutrient composition in fermentation broth.

Regarding claim 3, the term "established at a temperature and maintained" refers to said fermentation broth. Claim 1, lines 8-9,"subjecting said broth within said fermentation vessel to fermentation to form ethanol and carbon dioxide." Thus temperature within the broth is maintained to sustain fermentation. It is commonly known by one(s) practicing fermentation, that fermentation broth must be established at a temperature and maintained in order to sustain fermentation.

Taking into account claim 4, claim 4 is amended as follows: **4**. (amended) The method of claim **1** wherein said sugars, [capable of fermentation within which ethanol and carbon dioxide are produced,] are selected from the group consisting of [glucose and] glucose, xylose and mixtures thereof. Hence claim 4 within brackets and underlined glucose, has been amended to constitute a proper Markush group, without changing the scope of the claim.

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Concerning claim 5, the recitation "carbon dioxide containing humidified ethanol" is adequately defined within the specification page 5, lines 6-7, revealing, "The carbon dioxide containing humidified ethanol and carbon dioxide produced by fermentation is removed from the fermentation vessel and substantially separated from the ethanol."

Regarding claim 6, the recitation "capable of," claim 6 is amended as follows: **6**. (amended) The method of claim **1** wherein the microorganisms are yeasts [capable of] for forming enzymes required for fermentation to form ethanol and carbon dioxide. Therefore claim 6 is amended without changing the scope of the claim. The yeasts employed must form enzymes, such as xymase, required for fermentation of hexoses and pentoses to form ethanol and carbon dioxide within fermentation surroundings.

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Regarding claim 8, sludge is accompanied with fermentation broth and removed from the fermentation vessel. Claim **8.** states "The method of claim **1** wherein said sludge and broth removed from said fermentation vessel are settled within a vessel to substantially separate broth from sludge." This claim refers to a vessel for settling the sludge with accompanying continued fermentation. Within the specification page 8, lines 22-28, state, "Referring to **Fig. 3,** broth and sludge **14** is transmitted to separate stage **56** which functions to separate solution **10A** from sludge **58.** Separate stage **56,** for example, can be supplied by a microfiltration filter or a settling tank. Broth **10A** after separation is then recycled to the fermentation vessel **12** to regulate fermentation broth and combine with mixture **10.** Broth and sludge **14** may be concentrated by microfiltration to reduce volume to separation stage

56. Carbon dioxide **16A,** formed within separate stage **56,** during fermentation within separate stage **56** is combined with humidified carbon dioxide **18."** Thus the addition of within separate stage **56** within the specification page 8, lines 22-28, is intended to clarify the occurrence of fermentation. This amended claim is made without modifying the scope of the claim. Sludge and broth removed from the fermentation vessel are settled within a vessel thus stating that both vessels are involved in settling.

Concerning claim 9, the recitation within the specification page 5, lines 26-27, declares "Sludge, sugars, nutrients and microorganisms are removed from the fermentation vessel as required to maintain the volume of the fermentation broth." Stated by claim 9, "**9.** The method of claim **8** wherein the broth separated from the sludge is combined with said mixture of microorganisms, nutrients and sugars to maintain volume of broth within said fermentation vessel." Thus the volume of the fermentation broth is maintained by removal of sludge and fermentation broth to compensate for addition of solution.

Regarding claim 10, this claim is amended to replace [capable of] with employed for. Thus

BS **10.** (amended) The method of claim **1** wherein the microorganisms are [capable of] employed for forming enzymes required for fermentation to form ethanol and carbon dioxide. This amended claim is made without modifying the scope of the claim.

Regarding claims 11,12 and 17, the phrase " carbon dioxide containing humidified ethanol" is declared within the specification page 5, lines 6-7, "The carbon dioxide containing humidified ethanol and carbon dioxide produced by fermentation is removed from the fermentation vessel and substantially separated from the ethanol" to adequately define the phrase "carbon dioxide containing humidified ethanol." This phrase is also found within the specification page 1, lines 18-19.

Turning now to claim 13, the recitation "extractate" is the function to extract followed by ate to signify the product of extraction. The term "ate" is listed in Websters dictionary as a suffix for a function, for example, filtrate. The explanation by Websters dictionary adequately defines this term. Within claim 13, a solution containing ethanol is subjected to extraction by gasoline to produce an extractate of ethanol dissolved in gasoline and a solution substantially free of ethanol, which is a raffinate from this extraction. The function of extraction is described within several chemical engineering text books as well as taught within U S patent 6,258,175, page 5, lines 5-15.

Turning now to claim 14, please refer to remarks in the above section regarding the term extractate utilized within claim 13.

Turning now to claim 15, within quotes," **15.** The method of claim **13** wherein the solution substantially free of ethanol is distilled to produce vapor and a raffinate." Thus the function of distillation is defined to produce vapor and a raffinate. Composition of vapor and raffinate will depend on conditions of distillation., The function, distillation, is an accepted unit operation, and is described within several chemical engineering text books.

Turning now to claim 15, please refer to remarks in the above section regarding the term extractate utilized within claim 13.

Turning now to claim 16, Carbon dioxide is humidified and saturated by water and ethanol. The saturated carbon dioxide subjected to removal of ethanol but not water, so the carbon dioxide, saturated with water but not ethanol can be employed to humidify additional ethanol but not water. Quoting from claim 1, lines 14-15 "removing [means for separation of] ethanol from the separated humidified carbon dioxide to substantially remove ethanol from carbon dioxide to provide carbon dioxide to humidify ethanol. " Thus claim 1 establishes claim "**16.** The method of claim **1** wherein the carbon dioxide is humidified and saturated by water so that further humidification by the carbon dioxide will produce humidified ethanol from the fermentation broth without substantially producing humidified water from the fermentation broth."

Turning now to claim 18 and 19, both claims depend on claim 17, quoted, "The method of claim **1** wherein said humidified carbon dioxide, containing ethanol, is scrubbed by gasoline to provide gasohol containing ethanol and to provide carbon dioxide containing gasoline." As established earlier, humidified carbon dioxide, containing ethanol is saturated with water, thus humidified carbon dioxide contains both ethanol and water, and is subjected to scrubbing with gasoline to form gasohol containing water. Carbon dioxide, thus scrubbed, can be subjected to water to form humidified carbon dioxide saturated with water for further employment to humidify ethanol within fermentation broth without humidifying water.

Thus the claim language within all claims are lucid and clear and not vague or indefinite by one skilled in the art.

2. The fact that, to this date, no one has provided carbon dioxide to a fermentation broth, with the intention to humidify ethanol within the broth, thus the invention is both novel and unobvious.

3. The prior art of Hallberg and Tedder was considered not applicable to the present invention, as no method to humidify ethanol within fermentation broth by provided carbon dioxide has been disclosed. Disclosed by Hallberg and Tedder are methods to remove ethanol and carbon dioxide formed by fermentation to moderate concentration of ethanol within the broth. One of the

formed by fermentation to moderate concentration of ethanol within the broth. One of the primary objectives of the present invention is providing carbon dioxide to a fermentation broth to humidify ethanol within the broth.

4. The prior art of Hallberg, Tedder and Terpin et al. was considered not applicable to the present invention, as no method to humidify ethanol within fermentation broth by provided carbon dioxide has been disclosed. Disclosed by Hallberg and Tedder are methods to remove ethanol and carbon dioxide formed by fermentation to moderate concentration of ethanol within the broth. One of the prime objectives of the present invention is providing carbon dioxide to a fermentation broth to humidify ethanol within the broth.

5. The prior art of Hallberg, Tedder and Chambers was considered not applicable to the present invention, as no method to humidify ethanol within fermentation broth by provided carbon dioxide has been disclosed. Disclosed by Chambers is separation of water to form an azeotrope by vacuum distillation was investigated and found not applicable to the present invention. The object of the present invention is providing carbon dioxide to a fermentation broth to humidify ethanol within the broth. Furthermore the necessary fact that humidified ethanol within carbon dioxide is employed to bring about gasohol is not disclosed within the prior art.

In conclusion, Tedder claims extraction of ethanol from a fermentation liquor employing an organic solvent. Hallberg's teachings were found unrelated to the present invention and devoid of addition of carbon dioxide for the purpose of humidifying ethanol from a fermentation broth. Terpin, et al., releases broth from a fermentor to an extractor containing a low boiling alkalate to extract ethanol from the broth to form extracted ethanol in the low boiling alkalate for blending with gasoline to form gasohol.

Chambers' claims depend on distillation to remove ethanol from beer produced by fermentation. Ethanol vapor from the distillation is the combined with gasoline to form gasohol.

Concerning this communication from the examiner, an inquiry is unforeseen at this time.